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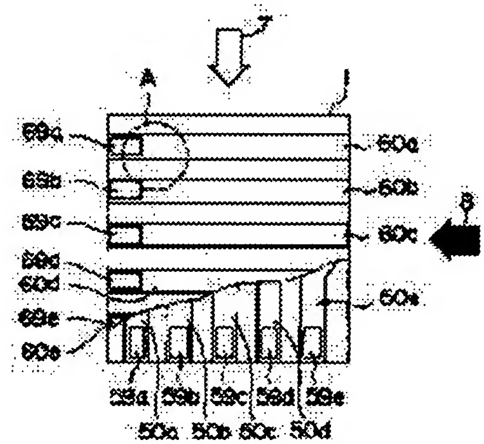
(54) FUEL CELL

(57)Abstract:
PURPOSE: To even temperature and current density within the cell surface of each unit cell for forming a fuel cell.
CONSTITUTION: Grooves 50, 60 are provided in a separator 1 of a unit cell to form a fuel gas flow passage 5 and an oxidant gas flow passage 6. Flow quantity control valves 59, 69, of which open degree is changed in response to the temperature, are provided in each groove 50, 60. When the temperature abnormally rises, the flow quantity control valve 59 arranged in the fuel gas flow passage 5 is closed to reduce the flow quantity of the fuel gas flowing in the groove 50. When the temperature abnormally rises, the flow quantity control valve 69 arranged in the oxidant gas flow passage 6 is opened to increase the quantity of the oxidant gas. Temperature control is performed from both views of the cooling ability and the quantity of heat generation so as to eliminate the temperature distribution within the cell surface, and the cell performance is stabilized and the lifetime thereof is prolonged.



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CLAIMS

[Claim(s)]
[Claim 1] The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte, The fuel cell characterized by being constituted including the fuel gas passage arranged in contact with the above-mentioned anode electrode, the oxidizer gas passageway arranged in contact with the above-mentioned cathode electrode, and the fuel control valve from which it is arranged all over the above-mentioned fuel gas passage, and an opening changes according to the temperature in the fuel gas passage concerned.
[Claim 2] The fuel cell according to claim 1 characterized by having further the oxidizer quantity-of-gas-flow control valve from which it is arranged in the above-mentioned oxidizer gas passageway, and an opening changes according to the temperature in the oxidizer gas passageway concerned.
[Claim 3] The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte, The fuel gas passage constituted including two or more fuel branch ways which touched the above-mentioned anode electrode and have been mutually arranged in juxtaposition, The fuel cell characterized by having the fuel-flow control means which can be adjusted for every fuel branch way for the flow rate of the fuel gas which flows the oxidizer gas passageway arranged in contact with the above-mentioned cathode electrode, and the above-mentioned fuel branch way.
[Claim 4] The above-mentioned fuel-flow control means is a fuel cell according to claim 3 characterized by being what adjusts the flow rate of the fuel gas which passes through the fuel branch way concerned according to the temperature of the fuel gas which passes through each above-mentioned fuel branch way.
[Claim 5] The flow control by the above-mentioned fuel-flow control means is a fuel cell according to claim 4 characterized by being what made in the direction which increases the flow rate of the fuel gas which the flow rate of the fuel gas which flows the fuel branch way concerned is decreased when the temperature of the above-mentioned fuel gas is high, and flows the fuel branch way concerned when the temperature of the above-mentioned fuel gas is low.
[Claim 6] The above-mentioned temperature is a fuel cell according to claim 4 or 5 characterized by being the temperature in the outlet section of the above-mentioned fuel branch way.
[Claim 7] The above-mentioned fuel-flow control means is a fuel cell according to claim 4 or 5 characterized by having the valve constituted including bimetal.
[Claim 8] The above-mentioned fuel-flow control means is a fuel cell according to claim 4 or 5 characterized by having the valve constituted including the shape memory alloy.
[Claim 9] The above-mentioned valve is a fuel cell according to claim 7 or 8 characterized by being arranged at the outlet section of the above-mentioned fuel branch way.
[Claim 10] The above-mentioned fuel-flow control means is a fuel cell according to claim 4 or 5 by which it is constituting-including temperature detection means [to detect the temperature of the above-mentioned fuel gas], and valve from which opening changes according to detection result of above-mentioned temperature detection means characterized.
[Claim 11] It is the fuel cell according to claim 7, 8, 9, or 10 which it has the separator which adjoined the above-mentioned anode electrode and has been arranged, and the above-mentioned separator is equipped with the slot which constitutes a part of above-mentioned fuel gas branch way in an opposed face with the above-mentioned anode electrode, and is characterized by arranging the above-mentioned valve at above-mentioned Mizouchi.
[Claim 12] The above-mentioned oxidizer gas passageway is a fuel cell according to claim 3, 4, 5, or 6 characterized by having further the oxidizer control-of-flow means which can be adjusted for every oxidizer branch way for the flow rate of the oxidizer gas which is constituted including two or more oxidizer branch ways mutually arranged in

juxtaposition, and flows the above-mentioned oxidizer branch way.

[Claim 13] The above-mentioned oxidizer control-of-flow means is a fuel cell according to claim 12 characterized by being what adjusts the flow rate of the oxidizer gas which passes through the oxidizer branch way concerned according to the temperature of the oxidizer gas which passes through the above-mentioned oxidizer branch way.

[Claim 14] The above-mentioned oxidizer control-of-flow means is a fuel cell according to claim 13 characterized by being what increases the flow rate of the oxidizer gas which will flow the branch way concerned if the flow rate of the oxidizer gas which flows the oxidizer branch way concerned will be decreased if the temperature of the above-mentioned oxidizer gas is high, and the temperature of the above-mentioned oxidizer gas is low.

[Claim 15] The above-mentioned anode electrode, an electrolyte attachment component, and a cathode electrode are a fuel cell according to claim 12 or 13 which carries out a laminating, is arranged, sees from [above-mentioned] a laminating, and is characterized by establishing the above-mentioned fuel branch way and the above-mentioned oxidizer branch way in the sense which crosses mutually.

[Claim 16] It is the fuel cell according to claim 3 or 12 which the above-mentioned fuel gas passage is further equipped with the fuel bypass passage which connects the above-mentioned fuel branch way mutually, and is characterized by the ability of the above-mentioned fuel-flow control means to adjust in independent the flow rate of the fuel gas which flows the above-mentioned fuel branch way before a crossing with the above-mentioned fuel bypass passage, and by the backside.

[Claim 17] It is the fuel cell according to claim 16 which the above-mentioned oxidizing agent gas passageway is further equipped with the oxidizing agent bypass passage which connects the above-mentioned oxidizing agent branch way mutually, and is characterized by the ability of the above-mentioned oxidizing agent control-of-flow means to adjust in independent the flow rate of the oxidizing agent gas which flows the above-mentioned oxidizing agent branch way before a crossing with the above-mentioned oxidizing agent bypass passage, and by the backside.

[Claim 18] The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte, The fuel gas passage arranged in contact with the above-mentioned anode electrode, and two or more oxidizer branch ways which have been arranged in contact with the above-mentioned cathode electrode, and have been mutually arranged in juxtaposition, The oxidizing agent gas passageway constituted including the oxidizing agent bypass passage which connects between these oxidizing agent branch ways, the flow rate of the fuel gas which flows the above-mentioned fuel branch way -- every oxidizing agent branch way -- and the fuel cell characterized by having the oxidizing agent control-of-flow means which can be adjusted in independent before a crossing with the above-mentioned oxidizing agent bypass passage, and the backside.

[Claim 19] The control approach of the fuel cell characterized by changing the fuel gas flow rate which flows the fuel gas passage concerned according to the temperature of the gas which has passed through the fuel gas passage arranged in contact with an anode electrode.

[Claim 20] Modification of the above-mentioned flow rate is the control approach of the fuel cell according to claim 19 characterized by being what performed in the direction which will increase the above-mentioned flow rate if the above-mentioned flow rate will be decreased if the above-mentioned temperature is high, and the above-mentioned temperature is low.

[Translation done.]

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the fuel cell which was built over the fuel cell, especially attained equalization of the temperature distribution within a cel side.
[0002]
[Description of the Prior Art] A fuel cell carries out direct conversion of the chemical energy to electrical energy using electrochemical reaction, and attracts attention as cleanness and the high generation-of-electrical-energy approach of an energy conversion efficiency, and researches and developments are energetically furthered towards utilization.
[0003] In order to use a fuel cell as a generation-of-electrical-energy system, it is necessary to make electrochemical reaction perform stably over a long period of time. And for that purpose, the temperature of a cell must be held uniformly. If cell temperature is too low, the cell engine performance will become low, and the life of a cell will become short if temperature is too high to objection. Therefore, temperature control is an element very important for a fuel cell. In addition, temperature changes with classes of electrolyte to be used, for example, is about 1000 degrees C in about 200 degrees C and a melting carbonate mold in a phosphoric-acid mold at about 650 degrees C and a solid oxide type.
[0004] By the way, one by one [cell], since the generated voltage is small, in order to use it as a fuel cell, it is necessary to accumulate and constitute many cells (cel) generally. Since the temperature of a cel differs for each cel of every, as for the above-mentioned temperature control, it is inadequate just to carry out collectively as the whole fuel cell. It is necessary to perform temperature control independently for every cel.
[0005] Furthermore, in order for various conditions (for example, a fuel gas flow rate, an oxidizer quantity of gas flow, the condition of an electrolyte plate, the condition of the condition cathode electrode of an anode electrode) to compound the temperature distribution of a cell and to act, the amount of generations of electrical energy and calorific value in an electrode surface change with the locations also about one cel. Consequently, the place where temperature is high, and a low place are made in the same cel side. Therefore, it is necessary to also equalize the temperature distribution in one cel.
[0006] Various techniques are proposed from the former that such temperature control should be realized. For example, in JP,63-16562,A, the cooling plate equipped with the quantity-of-gas-flow control strip which operates according to cel temperature is installed every number cel. And equalization of cel temperature distribution is used as the drawing wax by controlling the quantity of gas flow inside a cooling plate.
[0007] Moreover, like JP,63-41769,A and JP,613-58173,A, it deforms according to a temperature change and there is also an example equipped with the member (for example, bimetal) which controls a quantity of gas flow which prepared the heat sink.
[0008]
[Problem(s) to be Solved by the Invention] However, the above-mentioned conventional technique is a mounting beam thing about the cooling system of dedication, in order to cool the fuel cell elevated-temperature section. Therefore, there was a fault that the whole equipment was enlarged and complicated. Moreover, when priority was given to the miniaturizing point and simplification of equipment, there was a problem that the heat dissipation effectiveness and the temperature-distribution homogeneity effectiveness will become small.
[0009] Moreover, the temperature control in the above-mentioned conventional technique increased the amount of the heat which this oxidation gas takes by increasing fundamentally the flow rate of the cooling fluid (oxidation gas in this case) which flows an elevated-temperature part. That is, it depended only on increasing refrigeration capacity (capacity to take = heat) fundamentally. Therefore, there was also balance with the conversion efficiency mentioned later, and

there was a problem that sufficient temperature control could not be performed.
[0010] Furthermore, with the above-mentioned conventional technique, it was not fully able to opt for the temperature control within the same cel side, and it was not able to be performed finely. That is, the elevated-temperature section is distributed in the shape of a spot in the same cel side in many cases. On the other hand, oxidation gas flows and goes in the fixed direction in a 1 cel side. Therefore, when it was going to maintain this elevated-temperature section to the optimal temperature, there was a problem that the temperature in the circumference (especially upper part of this elevated-temperature section) of this elevated-temperature section will fall. And this had brought about the result of reducing the conversion efficiency to the electrical energy which is the selling point of fuel cell max. On the contrary, when such a point was taken into consideration, the flow rate of oxidation gas could seldom be increased, but there was a limitation in the range which can adjust temperature.
[0011] This invention aims at offering the fuel cell which attained current density within the cel side of each cel, and equalization of temperature distribution, without causing enlargement of the whole equipment, and complication.
[0012] This invention aims at offering the fuel cell which can perform temperature control, without depending only on adjustment of the cooling fluid flow.
[0013] This invention aims at offering the fuel cell which made more exact temperature control possible, pressing down the effect which it has on parts other than an abnormality part to the minimum.
[0014]
[Means for Solving the Problem] This invention is what was made in order to attain the above-mentioned object. As the 1st mode The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte, The fuel gas passage arranged in contact with the above-mentioned anode electrode, and the oxidizer gas passageway arranged in contact with the above-mentioned cathode electrode, It is arranged all over the above-mentioned fuel gas passage, and the fuel cell characterized by being constituted including the fuel control valve from which an opening changes according to the temperature in the fuel gas passage concerned is offered.
[0015] In this case, it is desirable to have further the oxidizer quantity-of-gas-flow control valve from which it is arranged in the above-mentioned oxidizer gas passageway, and an opening changes according to the temperature in the oxidizer gas passageway concerned.
[0016] The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte as the 2nd mode of this invention, The fuel gas passage constituted including two or more fuel branch ways which touched the above-mentioned anode electrode and have been mutually arranged in juxtaposition, The fuel cell characterized by having the fuel-flow control means which can be adjusted for every fuel branch way for the flow rate of the fuel gas which flows the oxidizer gas passageway arranged in contact with the above-mentioned cathode electrode and the above-mentioned fuel branch way is offered.
[0017] As for the above-mentioned fuel-flow control means, it is desirable that it is what adjusts the flow rate of the fuel gas which passes through the fuel branch way concerned according to the temperature of the fuel gas which passes through each above-mentioned fuel branch way.
[0018] The flow control by the above-mentioned fuel-flow control means decreases the flow rate of the fuel gas which flows the fuel branch way concerned, when the temperature of the above-mentioned fuel gas is high, and when the temperature of the above-mentioned fuel gas is low, it may be made in the direction which increases the flow rate of the fuel gas which flows the fuel branch way concerned.
[0019] As for the above-mentioned temperature, it is desirable that it is the temperature in the outlet section of the above-mentioned fuel branch way.
[0020] The above-mentioned fuel-flow control means may have the valve constituted including bimetal. Or the above-mentioned fuel-flow control means may have the valve constituted including the shape memory alloy.
[0021] As for the above-mentioned valve, it is desirable to be arranged at the outlet section of the above-mentioned fuel branch way.
[0022] As for the above-mentioned fuel-flow control means, it is desirable to be constituted including a temperature detection means to detect the temperature of the above-mentioned fuel gas, and the valve, from which an opening changes according to the detection result of the above-mentioned temperature detection means.
[0023] It has the separator which adjoined the above-mentioned anode electrode and has been arranged, and has the slot which constitutes a part of above-mentioned fuel gas branch way in an opposed face with the above-mentioned anode electrode of the above-mentioned separator, and the above-mentioned valve may be arranged at above-mentioned Mizouchi.

[0024] The above-mentioned oxidizer gas passageway is constituted including two or more oxidizer branch ways mutually arranged in juxtaposition, and may have further the oxidizer control-of-flow means which can be adjusted for every oxidizer branch way for the flow rate of the oxidizer gas which flows the above-mentioned oxidizer branch way.
[0025] As for the above-mentioned oxidizer control-of-flow means, it is desirable that it is what adjusts the flow rate of the oxidizer gas which passes through the oxidizer branch way concerned according to the temperature of the oxidizer gas which passes through the above-mentioned oxidizer branch way.
[0026] If the above-mentioned oxidizer control-of-flow means has the high temperature of the above-mentioned oxidizer gas, the flow rate of the oxidizer gas which flows the oxidizer branch way concerned will be decreased, and if the temperature of the above-mentioned oxidizer gas is low, the flow rate of the oxidizer gas which flows the branch way concerned may be increased.
[0027] The laminating of the above-mentioned anode electrode, an electrolyte attachment component, and the cathode electrode is carried out, they are arranged, are seen from [above-mentioned] a laminating, and it is desirable that the above-mentioned fuel branch way and the above-mentioned oxidizer branch way are established in the sense which crosses mutually.
[0028] The above-mentioned fuel gas passage is further equipped with the fuel bypass passage which connects the above-mentioned fuel branch way mutually, and, as for the above-mentioned fuel-flow control means, it is desirable for the flow rate of the fuel gas which flows the above-mentioned fuel branch way to be adjusted in independent before a crossing with the above-mentioned fuel bypass passage and by the backside.
[0029] The above-mentioned oxidizing agent gas passageway is further equipped with the oxidizing agent bypass passage which connects the above-mentioned oxidizing agent branch way mutually, and, as for the above-mentioned oxidizing agent control-of-flow means, it is still more desirable for the flow rate of the oxidizing agent gas which flows the above-mentioned oxidizing agent branch way to be adjusted in independent before a crossing with the above-mentioned oxidizing agent bypass passage and by the backside.
[0030] The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte as the 3rd mode of this invention, The fuel gas passage arranged in contact with the above-mentioned anode electrode, and two or more oxidizer branch ways which have been arranged in contact with the above-mentioned cathode electrode, and have been mutually arranged in juxtaposition, The oxidizing agent gas passageway constituted including the oxidizing agent bypass passage which connects between these oxidizing agent branch ways, the flow rate of the fuel gas which flows the above-mentioned fuel branch way -- every oxidizing agent branch way -- and the fuel cell characterized by having the oxidizing agent control-of-flow means which can be adjusted in independent before a crossing with the above-mentioned oxidizing agent bypass passage and the backside is offered.
[0031] According to the temperature in the fuel gas passage arranged in contact with the above-mentioned anode electrode as the 4th mode of this invention, the operating method of the fuel cell characterized by changing the fuel gas flow rate in the fuel gas passage concerned is offered.
[0032] If the above-mentioned temperature of modification of the above-mentioned flow rate is high, it will decrease the above-mentioned flow rate, and when the above-mentioned temperature is low, it may be performed in the direction which increases the above-mentioned flow rate.
[0033]
[Function] A fuel-flow control means adjusts the flow rate of the fuel gas which passes through the fuel branch way concerned according to the temperature (temperature especially in the outlet section) of the fuel gas which passes through each fuel branch way. This flow control decreases the flow rate of the fuel gas which flows the fuel branch way concerned, when the temperature of the above-mentioned fuel gas is high, and when the temperature of the above-mentioned fuel gas is low, it is performed in the direction which increases the flow rate of the fuel gas which flows the fuel branch way concerned. Thereby, fuel gas supply in the elevated-temperature section is controlled, and it controls, the reacting weight, i.e., the calorific value, in this elevated-temperature section.
[0034] Moreover, an oxidizer control-of-flow means adjusts the flow rate of the oxidizer gas which passes through the oxidizer branch way concerned according to the temperature (temperature especially in ********) of the oxidizer gas which flows an oxidizer branch way. If this flow control has the high temperature of oxidizer gas, it will decrease the flow rate of the oxidizer gas which flows the oxidizer branch way concerned, and if the temperature of the above-mentioned oxidizer gas is low, it will be performed in the direction which increases the flow rate of the oxidizer gas which flows the branch way concerned. The amount (refrigeration capacity in the elevated-temperature section) of the heat with which it increases and oxidizer gas takes the amount of supply of the oxidizer gas to the elevated-temperature section in this elevated-temperature section by this is increased.

[0035] In addition, in the low-temperature section, buildup of calorific value and control of refrigeration capacity are carried out to reverse with above-mentioned explanation.
[0036] If the fuel branch way and the oxidizer branch way are established in the sense which crosses mutually, in the abnormality section, the effectiveness of the above-mentioned calorific value control and the effectiveness of a cooling power force control will overlap, and it will act. Therefore, the greatest effectiveness can be acquired, minimizing the effect which it has on other normal fields.
[0037] In the example equipped with oxidizing agent bypass passage and fuel bypass passage, temperature etc. can be equalized more finely.
[0038]
[Example] The 1st example of this invention is explained using a drawing.
[0039] The fuel cell of this example generates electricity by making the fuel gas and oxidizer gas which are supplied with pumps 91 and 92 react as it is shown in drawing 1 . And the generated electrical and electric equipment is supplied to the load.
[0040] A fuel cell carries out the laminating of two or more cells, and is constituted. The configuration of the cell used as the bases of the fuel cell of this example is shown in drawing 2 .
[0041] This cell is constituted including the electrolyte plate 3, the anode electrode 2 and the cathode electrode 4 arranged on both sides of an electrolyte plate 3 at the both sides, and the separator 1. In addition, a separator 1 is for dividing between cells, and does not constitute a cell strictly. However, since a slot is established in the front face of this separator and this is usually made into passage, such as fuel gas, suppose that this separator is also treated as a component of a cell here.
[0042] A separator 1 divides between each cell. Two or more slots 50 which constitute the fuel gas passage 5 in the whole surface side of this separator 1 are established in parallel. On the other hand, two or more slots 60 of a separator 1 which constitute the oxidizer gas passageway 6 are similarly formed in the fuel gas passage 5 and the direction which goes direct at the side. It passes along the space where oxidizer gas is formed between a slot 60 and the cathode electrode 4 on the other hand in the space where fuel gas is formed between a slot 50 and the anode electrode 2, and has the structure of flowing in the respectively fixed direction.
[0043] Furthermore, although the separator 1 of this example is not drawn on drawing 2 , it equips each of a slot 50 with the flow control valve 59. Moreover, each of a slot 60 is equipped with this flow control valve 69. These flow control valves 59 and 69 are shown in drawing 3 .
[0044] A flow control valve 59 is for controlling current density and temperature by adjusting reacting weight (calorific value). The flow control valve 59 is arranged near the outlet of each slot 50, and opens and closes the outlet section of the slot 50 concerned according to the temperature of the fuel gas which has flowed the slot 50 concerned. The flow control valve 59 is constituted so that it may operate in the direction which will be closed if the temperature of fuel gas becomes higher than a design operating temperature (in namely, direction which reduces the flow rate of fuel gas) and may operate in the direction which will be opened if it becomes lower than a design operating temperature at reverse (in namely, direction which increases the flow rate of fuel gas). Moreover, each flow control valve 59 can operate in mutually-independent.
[0045] In this example, the flow control valve 59 is constituted using bimetal. A low expansion side ingredient is [an iron nickel alloy and the high expansion side ingredient of the construction material of the used bimetal] iron, manganese chromium, and an alloy. This flow control valve 59 is made into the configuration (it sets to this example and is a square shape) doubled with the configuration of a slot 50 so that a flow rate could be adjusted efficiently. Spot welding is performing anchoring to a separator 1. The configuration of a flow control valve 59 is not limited to this, and can use various configurations, such as circular and a semicircle, suitably. Moreover, not only welding but a bis-stop, integral-construction-izing with passage, etc. can apply other various approaches also about the mounting arrangement of a flow control valve 59.
[0046] A flow control valve 69 tends to control temperature by adjusting refrigeration capacity. A flow control valve 69 opens and closes the slot 60 concerned according to the temperature of oxidizer gas. Although this flow control valve 69 is the same as a flow control valve 59 fundamentally, as for the flow control valve 59, the actuation direction of the valve to a temperature change is made into reverse. That is, the flow control valve 69 is constituted so that it may operate in the direction which will be opened if the temperature of oxidizer gas becomes higher than a design operating temperature (in namely, direction which increases the flow rate of oxidizer gas) and may operate in the direction which will be closed if it becomes lower than a design operating temperature (in namely, direction which reduces the flow rate of oxidizer gas).
[0047] A separator 1 and the anode electrode 2 are determined for the construction material of the cathode electrode 4

and an electrolyte plate 3, a configuration, etc. according to the class of fuel cell. For example, when using a melting carbonate as an electrolyte, stainless steel can be used as a separator 1, and the porous body of a nickel alloy can be used as the anode electrode 2 and a cathode electrode 3. Moreover, the porous body of an alumina or magnesium can be used as an electrolyte plate 3.

[0048] The "fuel-flow control means" said in a claim is equivalent to a flow control valve 59 in this example. An "oxidizer control-of-flow means" is equivalent to a flow control valve 69. Moreover, a "fuel branch way" is equivalent to the space formed in each slot 50 and anode electrode 2. "The fuel branch way mutually arranged in juxtaposition" means the physical relationship slot 50a, b, c and d, and between e. Moreover, it realizes with the "oxidizer branch way" as space formed with each slot 60 and cathode electrode 3. "The oxidizer branch way mutually arranged in juxtaposition" means the physical relationship slot 60a, b, c and d, and between e.

[0049] The temperature control actuation in the fuel cell of this example is explained using drawing 4 .

[0050] drawing 4 showed signs that the cel of the fuel cell of this example was seen from the upside -- it is. In addition, since the structure of the fuel gas passage 5 is expressed, the part is used as perspective drawing. Moreover, it drew with the circle of a broken line by making into the abnormality section A the elevated-temperature part (or low-temperature part) generated in the cel side. In the slot 50, fuel gas 7 shall flow in the direction of a void arrow head. In the slot 60, oxidizer gas 8 shall flow in the direction of a black-colored arrow head.

[0051] Fuel gas 7 is supplied to the anode electrode 2 through a slot 50. Oxidizer gas 8 is similarly supplied to the cathode electrode 4 through a slot 60. And the electrical and electric equipment and heat are generated according to electrochemical reaction all over the anode electrode 2 and the cathode electrode 4.

[0052] When the current density and temperature in the abnormality section A are high unusually, slot 50a in the location corresponding to this abnormality section A and the fuel gas 7 which has passed b are an elevated temperature. Therefore, flow control valves 59a and 59b operate in the close direction, and the flow rate of the fuel gas 7 which flows through Slots 50a and 50b is decreased. Consequently, the reacting weight (namely, calorific value) of the electrochemical reaction in the field in alignment with slot 50a and b decreases, and current density and temperature fall.

[0053] With the fuel cell, the amount of supply of whole fuel cell Di's fuel gas is controlled by the pump 91 grade (refer to drawing 1). Therefore, only in the part by which the amount of the fuel gas 7 which flows Slots 50a and 50b was decreased, the amount of supply of fuel gas does not decrease as it is. The amount of the fuel gas 7 with which only the amount equivalent to at least the part of these decrements flows Slots 50c, 50d, and 50e increases. By this, while maintaining the output value in the whole fuel cell, equalization of the current density distribution and temperature distribution in the whole cel side can be attained. In such semantics, the flow control valve 59 will also demonstrate the distribution frame of the fuel gas to each slot 50. About this point, the same is said of a flow control valve 69.

[0054] The oxidizer gas 8 which has passed through Slots 60a and b is an elevated temperature similarly. Therefore, flow control valves 69a and 69b operate in the open direction, and increase the flow rate of the oxidizer gas 8 which flows Slots 60a and 60b. Consequently, the refrigeration capacity in the field along Slots 60a and 60b can increase, and the temperature in this field can be lowered.

[0055] When the current density and temperature in the abnormality section A are falling unusually, it acts on reverse with the above. That is, flow control valves 59a and 59b operate in the open direction, and the flow rate of the fuel gas 7 which flows through Slots 50a and 50b increases. Consequently, the reacting weight (namely, calorific value) of the electrochemical reaction in the field in alignment with slot 50a and b increases, and the current density and temperature in this field increase. Moreover, flow control valves 69a and 69b operate in the close direction, and the flow rate of the oxidizer gas 8 which flows through Slots 60a and 60b decreases. Consequently, the refrigeration capacity in the field along Slots 60a and 60b declines, and the temperature in this field increases.

[0056] In the part (the abnormality section A in this case) on which control (or buildup) of the calorific value according [the adjustment function of the current density and temperature which are realized by such mechanism] to a flow control valve 59, and buildup (or control) of the refrigeration capacity by the flow control valve 69 overlap and act, it will be demonstrated most effectively.

[0057] this example -- each slot 50 -- (-- although the flow control valve 59 (69) is attached in every 60), respectively, you may make it form a flow control valve 59 (69) like drawing 5 , after summarizing two or more slots 50 (60) to one Cost reduction can be planned if it does in this way. On the contrary, two or more flow control valves 59 (69) may be formed in one slot 50 (60) like drawing 6 . If it does in this way, the range which can adjust a flow rate will become large.

[0058] The 2nd example of this invention is explained using drawing 7 .

[0059] This example is characterized by preparing flow-control-valve 59' (69') also in a just before [the intersection of a slot 50 (60) and the bypass slot 52 (62)] location while it forms the bypass slot 52 (62) which connects between each slot 50 of separator 1' (60). the part which is in the upstream from the bypass slot 52 (62) of a slot 50 (60) hereafter -- slot 50' (60') -- moreover, the part in the downstream is called slot 50" (60").
[0060] The configuration of flow-control-valve 59' and 69' itself is the same as that of the 1st example of the above. Moreover, it is the same as that of the 1st example of the above about other parts. In addition, drawing where drawing 7 (a) looked at separator 1' from the slot 50 side, and drawing 7 (b) are drawings which looked at separator 1' from the slot 60 side.
[0061] The bypass slot 52 (62) is formed so that between each slot 50 (60) may be connected. Thereby, not only the gas that has passed slot 50'a but a part of gas which has passed slot 50'b, and c, d and e can flow into slot 50a." Moreover, the inflow not only to slot 50a" but slot 50'b, and c, d and e of the gas which has passed slot 50'a conversely is attained.
[0062] In addition, slot 50' and slot 50" constitute "fuel branch way" where each is another. On the other hand, "the fuel branch way mutually arranged in juxtaposition" means the physical relationship slot 50'a, b, c and d, the physical relationship between e and slot 50"a, b, c and d, and between e. Similarly, the oxidizer branch way arranged in juxtaposition means the physical relationship slot 60'a, b, c and d, the physical relationship between e and slot 60"a, b, c and d, and between e.
[0063] Actuation is explained.
[0064] abnormalities -- the section -- B -- it can set -- current density -- and -- temperature -- unusual -- high -- becoming -- **** -- a case -- **** -- this -- abnormalities -- the section -- B -- immediately after -- a location -- it is -- a flow control valve -- 59 -- a -- ' -- 59 -- b -- ' -- the close direction -- operating . Then, the flow rate of slot 50a' and the fuel gas 7 which flows into 50b' decreases. Consequently, the reacting weight (namely, calorific value) of the electrochemical reaction in slot 50a' and the field (that is, the abnormality section B) in alignment with 50b' decreases, and current density and temperature fall.
[0065] a slot -- 50 -- a -- ' -- 50 -- b -- ' -- flowing -- fuel gas -- seven -- an amount -- having decreased -- a part -- inside -- at least -- a part -- a slot -- 50 -- c -- ' -- 50 -- d -- ' -- 50 -- e -- ' -- flowing . and -- a slot -- 50 -- a -- " -- 50 -- b -- " -- **** -- a slot -- 50 -- a -- ' -- 50 -- b -- ' -- passing -- having flowed -- gas -- not only -- a slot -- 50 -- c -- ' -- 50 -- d -- ' -- 50 -- e -- ' -- passing -- having flowed -- gas -- the pie bus slot 52 -- leading -- flowing in . Therefore, fuel gas is fully supplied to this slot 50a" and the field in alignment with 50b." That is, since fuel gas bypasses the abnormality section B and flows, it can make small the adverse effect which it has on parts other than the abnormality section B (the example of drawing 7 especially downstream part of the abnormality section B). Unlike the example of drawing 7 , when the abnormality section B arises in the downstream (that is, field of slot 50") more, similarly, fuel gas can bypass the abnormality section B and can flow.
[0066] on the other hand -- this -- abnormalities -- the section -- B -- immediately after -- a location -- it is -- a flow control valve -- 69 -- a -- ' -- 69 -- b -- ' -- the open direction -- operating . Then, the flow rate of slot 60a' and the oxidizer gas 8 which flows into 60b' increases, and the refrigeration capacity in the field in alignment with slot 60a' and 60b' increases. Consequently, the temperature of the abnormality section B falls.
[0067] a slot -- 60 -- a -- ' -- 60 -- b -- ' -- flowing -- an oxidizer -- gas -- eight -- an amount -- having increased -- a part -- only -- a slot -- 60 -- c -- ' -- 60 -- d -- ' -- 60 -- e -- ' -- flowing -- an oxidizer -- gas -- eight -- an amount -- decreasing . however -- a slot -- 60 -- c -- ' -- 60 -- d -- ' -- 60 -- e -- ' -- each -- ******** -- seeing -- if -- since the decrement is small -- an adverse effect -- there is nothing .
[0068] a slot -- 60 -- a -- ' -- 60 -- b -- ' -- passing -- having flowed -- an oxidizing agent -- gas -- a slot -- 60 -- a -- " -- 60 -- b -- " -- not only -- a pie -- a bus -- a slot -- 62 -- leading -- a slot -- 60 -- c -- " -- 60 -- d -- " -- 60 -- e -- " -- flowing in . Therefore, it is not in 60b" this slot 60a" and that the oxidizer gas of a large quantity flows in. That is, since oxidizer gas spreads in the whole again after it gathers from the whole oxidizer passage and cools the abnormality section B intensively, it can make small effect which it has on parts other than the abnormality section B (especially the downstream part and upstream part of the abnormality section B).
[0069] Finer control will be attained if many bypass slots 52 (62) are formed further.
[0070] In this 2nd example, while maintaining the output value in the whole fuel cell, much more equalization of the current density distribution and temperature distribution in the whole cel side can be attained.
[0071] Since each example explained above acts from the field of the both sides of refrigeration capacity and calorific value, it can perform control of current density and temperature effectively. Moreover, it is efficient in order to act on an abnormality elevated-temperature (low temperature) part intensively. Since lowering of the amount of generations of electrical energy accompanying temperature control is suppliable in other normal parts, when it sees as the whole fuel cell, there is almost no lowering of an output. In order to **** and to make small reduction of the generation efficiency

of the fuel cell itself as much as possible, as for buildup of refrigeration capacity, using as an auxiliary means is desirable.

[0072] In addition, the effectiveness by adjustment of such refrigeration capacity is useful especially in the fuel cell of the type which uses oxidizer gas for cooling essentially, i.e., a fused carbonate fuel cell etc.

[0073] When exact temperature control became possible, the partial corrosion within a cel side, deformation, scattering by electrolytic evaporation, etc. can be prevented. Moreover, useless consumption of fuel gas can be prevented. Furthermore, by having equalized current density distribution, the cel engine performance improves and generation efficiency rises. Moreover, the generation-of-electrical-energy inaction by lowering of temperature is also cancelable.

[0074] Moreover, since a complicated controlling mechanism etc. is not needed, it is advantageous also in respect of the dependability of equipment, and a manufacturing cost.

[0075] Furthermore, the configuration of this example may function also as an insurance device exceeding a role of a controlling mechanism of mere temperature and current density. That is, since flow control valves 59 and 69 operate in mutually-independent altogether, an overrun can be stopped because it will be in the condition which all the flow control valves 59 closed, and the condition that all the flow control valves 69 opened when a fuel cell begins an overrun (or beforehand prevention). And the dependability is extremely excellent. Generally, the insurance device is not operating at all, while the device (fuel cell in this case) is operating normally. Therefore, when accident occurs, it cannot usually check whether the insurance device operates normally. However, in this example, since it is operating from usually as controlling mechanisms, such as temperature, it can always check operating normally.

[0076] In the above-mentioned example, flow control valves 59 and 69 were realized using bimetal. However, the concrete implementation approach is not limited to this and may use a shape memory alloy. As a shape memory alloy, there are a TiNiNb alloy, a FeNiC alloy, a FeMnSi alloy, etc. What kind of thing is used should just choose suitably in accordance with a service condition etc.

[0077] Furthermore, the components of 1 do not necessarily need to combine the function which detects temperature, and the valve function to adjust a flow rate according to the detected temperature. For example, you may realize by combining the temperature sensor of a thermocouple, and the valve in which opening adjustment is possible. In addition, even when a temperature detection function and the flow adjustability are divided and considered in this way, as for the field set as the object of temperature detection, it is desirable that it is the outlet section of passage (slots 50 and 60). This is because the abnormalities caused in the downstream rather than the temperature detection object domain concerned are undetectable if temperature detection is performed in the middle of passage (slots 50 and 60). On the other hand, it is not necessary to necessarily arrange the valve for adjusting a flow rate in the outlet section of passage. Even if a valve arranges in the middle of the entry of passage etc. in which location, it is because it is possible to adjust the flow rate of the passage (slots 50 and 60) concerned.

[0078] The above-mentioned example was equipped with both the flow control valve 59 and the flow control valve 69. However, a certain amount of effectiveness also as a configuration equipped only with either is expectable.

[0079] Since the above-mentioned example aimed also at attaining equalization of the temperature within a cel side, and current density, it had prepared two or more branch ways juxtaposition-wise and in serial. Moreover, the passage of oxidizer gas and the passage of fuel gas were established in sense which crosses mutually. However, if it aims only at maintaining temperature at the predetermined range, need to divide passage and it is not necessary to establish it in plurality. Also when this example is applied without dividing passage into plurality, temperature control can be performed to accuracy. This is because detection of temperature etc. is performed immediately near the exoergic section.

[0080] Finally, the range which can apply the above-mentioned above-mentioned example is described.

[0081] The above-mentioned example explained only paying attention to the field of reacting weight control, without touching on fuel gas on the side face as a cooling medium. However, fuel gas may also function also as a cooling medium actually. Moreover, it is possible to also use oxidizer gas for reverse at reacting weight control. Therefore, in case this invention is applied, it is necessary to take the following points into consideration. However, the above-mentioned example is applicable to the bottom of the service condition of the fuel cell with which researches and developments are done actually as it is.

[0082] Reacting weight can apply the above-mentioned example to the bottom of a service condition which is not the flow rate of oxidizer gas and is determined with the flow rate of fuel gas (that is, service condition in which oxidizer gas exists superfluously to fuel gas). In operational status in which fuel gas exists superfluously to oxidizer gas, even if it controls the flow rate of fuel gas, reacting weight cannot be adjusted. Under such a service condition, when the flow rate of fuel gas is reduced, it is only only causing reduction of the cooling effect by fuel gas. Moreover, when the flow rate of oxidizer gas is increased, reacting weight is made to increase on the contrary. To the bottom of such a service

condition, flow control of oxidizer gas can perform control of reacting weight, and the flow rate of fuel gas can perform control of refrigeration capacity. Therefore, the actuation direction of flow control valves 59 and 69 is made into the above-mentioned example in this case at reverse. That is, if temperature becomes high, a flow control valve 59 will open and, on the other hand, a flow control valve 69 will be closed.

[0083] Moreover, if the fixed level which has a fuel gas flow rate under a service condition in which oxidizing agent gas exists superfluously to fuel gas is exceeded, even if it will increase a flow rate more than it, reacting weight hardly increases. In such a operating range, buildup of a fuel gas flow rate makes the amount (that is, cooling operation by fuel gas) of the heat which fuel gas takes increase, and it acts so that temperature may be reduced to a fuel cell. Therefore, it is necessary to determine the adjustable range of a flow rate in consideration of such a point. In addition, the existing fixed level is determined by various conditions, such as a diffusion rate of reacting matter, thickness of a diffusion layer, and a condition of an electrode surface, the account of a top.

[0084]

[Effect of the Invention] According to this invention, the current density distribution and temperature distribution within the cel side of a fuel cell can be equalized as explained above. Moreover, the corrosion of the cel member by abnormality generation of heat within a cel side, deformation by the thermal expansion of a cel member, scattering by electrolytic evaporation, etc. can be controlled. Moreover, the utilization factor of fuel gas improves and generation efficiency rises.

[Translation done.]

TECHNICAL FIELD

[Industrial Application] This invention relates to the fuel cell which was built over the fuel cell, especially attained equalization of the temperature distribution within a cel side.

[Translation done.]

PRIOR ART

[Description of the Prior Art] A fuel cell carries out direct conversion of the chemical energy to electrical energy using electrochemical reaction, and attracts attention as cleanness and the high generation-of-electrical-energy approach of an energy conversion efficiency, and researches and developments are energetically furthered towards utilization.
[0003] In order to use a fuel cell as a generation-of-electrical-energy system, it is necessary to make electrochemical reaction perform stably over a long period of time. And for that purpose, the temperature of a cell must be held uniformly. If cell temperature is too low, the cell engine performance will become low, and the life of a cell will become short if temperature is too high to objection. Therefore, temperature control is an element very important for a fuel cell. In addition, temperature changes with classes of electrolyte to be used, for example, is about 1000 degrees C in about 200 degrees C and a melting carbonate mold in a phosphoric-acid mold at about 650 degrees C and a solid oxide type.
[0004] By the way, one by one [cell], since the generated voltage is small, in order to use it as a fuel cell, it is necessary to accumulate and constitute many cells (cel) generally. Since the temperature of a cel differs for each cel of every, as for the above-mentioned temperature control, it is inadequate just to carry out collectively as the whole fuel cell. It is necessary to perform temperature control independently for every cel.
[0005] Furthermore, in order for various conditions (for example, a fuel gas flow rate, an oxidizer quantity of gas flow, the condition of an electrolyte plate, the condition of the condition cathode electrode of an anode electrode) to compound the temperature distribution of a cell and to act, the amount of generations of electrical energy and calorific value in an electrode surface change with the locations also about one cel. Consequently, the place where temperature is high, and a low place are made in the same cel side. Therefore, it is necessary to also equalize the temperature distribution in one cel.
[0006] Various techniques are proposed from the former that such temperature control should be realized. For example, in JP,63-16562,A, the cooling plate equipped with the quantity-of-gas-flow control strip which operates according to cel temperature is installed every number cel. And equalization of cel temperature distribution is used as the drawing wax by controlling the quantity of gas flow inside a cooling plate.
[0007] Moreover, like JP,63-41769,A and JP,613-58173,A, it deforms according to a temperature change and there is also an example equipped with the member (for example, bimetal) which controls a quantity of gas flow which prepared the heat sink.

[Translation done.]

EFFECT OF THE INVENTION

[Effect of the Invention] According to this invention, the current density distribution and temperature distribution within the cel side of a fuel cell can be equalized as explained above. Moreover, the corrosion of the cel member by abnormality generation of heat within a cel side, deformation by the thermal expansion of a cel member, scattering by electrolytic evaporation, etc. can be controlled. Moreover, the utilization factor of fuel gas improves and generation efficiency rises.

[Translation done.]

TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] However, the above-mentioned conventional technique is a mounting beam thing about the cooling system of dedication, in order to cool the fuel cell elevated-temperature section. Therefore, there was a fault that the whole equipment was enlarged and complicated. Moreover, when priority was given to the miniaturizing point and simplification of equipment, there was a problem that the heat dissipation effectiveness and the temperature-distribution homogeneity effectiveness will become small.
[0009] Moreover, the temperature control in the above-mentioned conventional technique increased the amount of the heat which this oxidation gas takes by increasing fundamentally the flow rate of the cooling fluid (oxidation gas in this case) which flows an elevated-temperature part. That is, it depended only on increasing refrigeration capacity (capacity to take = heat) fundamentally. Therefore, there was also balance with the conversion efficiency mentioned later, and there was a problem that sufficient temperature control could not be performed.
[0010] Furthermore, with the above-mentioned conventional technique, it was not fully able to opt for the temperature control within the same cel side, and it was not able to be performed finely. That is, the elevated-temperature section is distributed in the shape of a spot in the same cel side in many cases. On the other hand, oxidation gas flows and goes in the fixed direction in a 1 cel side. Therefore, when it was going to maintain this elevated-temperature section to the optimal temperature, there was a problem that the temperature in the circumference (especially upper part of this elevated-temperature section) of this elevated-temperature section will fall. And this had brought about the result of reducing the conversion efficiency to the electrical energy which is the selling point of fuel cell max. On the contrary, when such a point was taken into consideration, the flow rate of oxidation gas could seldom be increased, but there was a limitation in the range which can adjust temperature.
[0011] This invention aims at offering the fuel cell which attained current density within the cel side of each cel, and equalization of temperature distribution, without causing enlargement of the whole equipment, and complication.
[0012] This invention aims at offering the fuel cell which can perform temperature control, without depending only on adjustment of the cooling fluid flow.
[0013] This invention aims at offering the fuel cell which made more exact temperature control possible, pressing down the effect which it has on parts other than an abnormality part to the minimum.

[Translation done.]

MEANS

[Means for Solving the Problem] This invention is what was made in order to attain the above-mentioned object. As the 1st mode The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte, The fuel gas passage arranged in contact with the above-mentioned anode electrode, and the oxidizer gas passageway arranged in contact with the above-mentioned cathode electrode, It is arranged all over the above-mentioned fuel gas passage, and the fuel cell characterized by being constituted including the fuel control valve from which an opening changes according to the temperature in the fuel gas passage concerned is offered.
[0015] In this case, it is desirable to have further the oxidizer quantity-of-gas-flow control valve from which it is arranged in the above-mentioned oxidizer gas passageway, and an opening changes according to the temperature in the oxidizer gas passageway concerned.
[0016] The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte as the 2nd mode of this invention, The fuel gas passage constituted including two or more fuel branch ways which touched the above-mentioned anode electrode and have been mutually arranged in juxtaposition, The fuel cell characterized by having the fuel-flow control means which can be adjusted for every fuel branch way for the flow rate of the fuel gas which flows the oxidizer gas passageway arranged in contact with the above-mentioned cathode electrode and the above-mentioned fuel branch way is offered.
[0017] As for the above-mentioned fuel-flow control means, it is desirable that it is what adjusts the flow rate of the fuel gas which passes through the fuel branch way concerned according to the temperature of the fuel gas which passes through each above-mentioned fuel branch way.
[0018] The flow control by the above-mentioned fuel-flow control means decreases the flow rate of the fuel gas which flows the fuel branch way concerned, when the temperature of the above-mentioned fuel gas is high, and when the temperature of the above-mentioned fuel gas is low, it may be made in the direction which increases the flow rate of the fuel gas which flows the fuel branch way concerned.
[0019] As for the above-mentioned temperature, it is desirable that it is the temperature in the outlet section of the above-mentioned fuel branch way.
[0020] The above-mentioned fuel-flow control means may have the valve constituted including bimetal. Or the above-mentioned fuel-flow control means may have the valve constituted including the shape memory alloy.
[0021] As for the above-mentioned valve, it is desirable to be arranged at the outlet section of the above-mentioned fuel branch way.
[0022] As for the above-mentioned fuel-flow control means, it is desirable to be constituted including a temperature detection means to detect the temperature of the above-mentioned fuel gas, and the valve, from which an opening changes according to the detection result of the above-mentioned temperature detection means.
[0023] It has the separator which adjoined the above-mentioned anode electrode and has been arranged, and has the slot which constitutes a part of above-mentioned fuel gas branch way in an opposed face with the above-mentioned anode electrode of the above-mentioned separator, and the above-mentioned valve may be arranged at above-mentioned Mizouchi.
[0024] The above-mentioned oxidizer gas passageway is constituted including two or more oxidizer branch ways mutually arranged in juxtaposition, and may have further the oxidizer control-of-flow means which can be adjusted for every oxidizer branch way for the flow rate of the oxidizer gas which flows the above-mentioned oxidizer branch way.
[0025] As for the above-mentioned oxidizer control-of-flow means, it is desirable that it is what adjusts the flow rate of the oxidizer gas which passes through the oxidizer branch way concerned according to the temperature of the oxidizer

gas which passes through the above-mentioned oxidizer branch way.
[0026] If the above-mentioned oxidizer control-of-flow means has the high temperature of the above-mentioned oxidizer gas, the flow rate of the oxidizer gas which flows the oxidizer branch way concerned will be decreased, and if the temperature of the above-mentioned oxidizer gas is low, the flow rate of the oxidizer gas which flows the branch way concerned may be increased.
[0027] The laminating of the above-mentioned anode electrode, an electrolyte attachment component, and the cathode electrode is carried out, they are arranged, are seen from [above-mentioned] a laminating, and it is desirable that the above-mentioned fuel branch way and the above-mentioned oxidizer branch way are established in the sense which crosses mutually.
[0028] The above-mentioned fuel gas passage is further equipped with the fuel bypass passage which connects the above-mentioned fuel branch way mutually, and, as for the above-mentioned fuel-flow control means, it is desirable for the flow rate of the fuel gas which flows the above-mentioned fuel branch way to be adjusted in independent before a crossing with the above-mentioned fuel bypass passage and by the backside.
[0029] The above-mentioned oxidizing agent gas passageway is further equipped with the oxidizing agent bypass passage which connects the above-mentioned oxidizing agent branch way mutually, and, as for the above-mentioned oxidizing agent control-of-flow means, it is still more desirable for the flow rate of the oxidizing agent gas which flows the above-mentioned oxidizing agent branch way to be adjusted in independent before a crossing with the above-mentioned oxidizing agent bypass passage and by the backside.
[0030] The electrolyte attachment component which is arranged between an anode electrode, a cathode electrode, and the above-mentioned anode electrode and the above-mentioned cathode electrode, and holds an electrolyte as the 3rd mode of this invention, The fuel gas passage arranged in contact with the above-mentioned anode electrode, and two or more oxidizer branch ways which have been arranged in contact with the above-mentioned cathode electrode, and have been mutually arranged in juxtaposition, The oxidizing agent gas passageway constituted including the oxidizing agent bypass passage which connects between these oxidizing agent branch ways, the flow rate of the fuel gas which flows the above-mentioned fuel branch way -- every oxidizing agent branch way -- and the fuel cell characterized by having the oxidizing agent control-of-flow means which can be adjusted in independent before a crossing with the above-mentioned oxidizing agent bypass passage and the backside is offered.
[0031] According to the temperature in the fuel gas passage arranged in contact with the above-mentioned anode electrode as the 4th mode of this invention, the operating method of the fuel cell characterized by changing the fuel gas flow rate in the fuel gas passage concerned is offered.
[0032] If the above-mentioned temperature of modification of the above-mentioned flow rate is high, it will decrease the above-mentioned flow rate, and when the above-mentioned temperature is low, it may be performed in the direction which increases the above-mentioned flow rate.

[Translation done.]

OPERATION

[Function] A fuel-flow control means adjusts the flow rate of the fuel gas which passes through the fuel branch way concerned according to the temperature (temperature especially in the outlet section) of the fuel gas which passes through each fuel branch way. This flow control decreases the flow rate of the fuel gas which flows the fuel branch way concerned, when the temperature of the above-mentioned fuel gas is high, and when the temperature of the above-mentioned fuel gas is low, it is performed in the direction which increases the flow rate of the fuel gas which flows the fuel branch way concerned. Thereby, fuel gas supply in the elevated-temperature section is controlled, and it controls, the reacting weight, i.e., the calorific value, in this elevated-temperature section.
[0034] Moreover, an oxidizer control-of-flow means adjusts the flow rate of the oxidizer gas which passes through the oxidizer branch way concerned according to the temperature (temperature especially in ********) of the oxidizer gas which flows an oxidizer branch way. If this flow control has the high temperature of oxidizer gas, it will decrease the flow rate of the oxidizer gas which flows the oxidizer branch way concerned, and if the temperature of the above-mentioned oxidizer gas is low, it will be performed in the direction which increases the flow rate of the oxidizer gas which flows the branch way concerned. The amount (refrigeration capacity in the elevated-temperature section) of the heat with which it increases and oxidizer gas takes the amount of supply of the oxidizer gas to the elevated-temperature section in this elevated-temperature section by this is increased.
[0035] In addition, in the low-temperature section, buildup of calorific value and control of refrigeration capacity are carried out to reverse with above-mentioned explanation.
[0036] If the fuel branch way and the oxidizer branch way are established in the sense which crosses mutually, in the abnormality section, the effectiveness of the above-mentioned calorific value control and the effectiveness of a cooling power force control will overlap, and it will act. Therefore, the greatest effectiveness can be acquired, minimizing the effect which it has on other normal fields.
[0037] In the example equipped with oxidizing agent bypass passage and fuel bypass passage, temperature etc. can be equalized more finely.

[Translation done.]

EXAMPLE

[Example] The 1st example of this invention is explained using a drawing.
[0039] The fuel cell of this example generates electricity by making the fuel gas and oxidizer gas which are supplied with pumps 91 and 92 react as it is shown in drawing 1 . And the generated electrical and electric equipment is supplied to the load.
[0040] A fuel cell carries out the laminating of two or more cells, and is constituted. The configuration of the cell used as the bases of the fuel cell of this example is shown in drawing 2 .
[0041] This cell is constituted including the electrolyte plate 3, the anode electrode 2 and the cathode electrode 4 arranged on both sides of an electrolyte plate 3 at the both sides, and the separator 1. In addition, a separator 1 is for dividing between cells, and does not constitute a cell strictly. However, since a slot is established in the front face of this separator and this is usually made into passage, such as fuel gas, suppose that this separator is also treated as a component of a cell here.
[0042] A separator 1 divides between each cell. Two or more slots 50 which constitute the fuel gas passage 5 in the whole surface side of this separator 1 are established in parallel. On the other hand, two or more slots 60 of a separator 1 which constitute the oxidizer gas passageway 6 are similarly formed in the fuel gas passage 5 and the direction which goes direct at the side. It passes along the space where oxidizer gas is formed between a slot 60 and the cathode electrode 4 on the other hand in the space where fuel gas is formed between a slot 50 and the anode electrode 2, and has the structure of flowing in the respectively fixed direction.
[0043] Furthermore, although the separator 1 of this example is not drawn on drawing 2 , it equips each of a slot 50 with the flow control valve 59. Moreover, each of a slot 60 is equipped with this flow control valve 69. These flow control valves 59 and 69 are shown in drawing 3 .
[0044] A flow control valve 59 is for controlling current density and temperature by adjusting reacting weight (calorific value). The flow control valve 59 is arranged near the outlet of each slot 50, and opens and closes the outlet section of the slot 50 concerned according to the temperature of the fuel gas which has flowed the slot 50 concerned. The flow control valve 59 is constituted so that it may operate in the direction which will be closed if the temperature of fuel gas becomes higher than a design operating temperature (in namely, direction which reduces the flow rate of fuel gas) and may operate in the direction which will be opened if it becomes lower than a design operating temperature at reverse (in namely, direction which increases the flow rate of fuel gas). Moreover, each flow control valve 59 can operate in mutually-independent.
[0045] In this example, the flow control valve 59 is constituted using bimetal. A low expansion side ingredient is [an iron nickel alloy and the high expansion side ingredient of the construction material of the used bimetal] iron, manganese chromium, and an alloy. This flow control valve 59 is made into the configuration (it sets to this example and is a square shape) doubled with the configuration of a slot 50 so that a flow rate could be adjusted efficiently. Spot welding is performing anchoring to a separator 1. The configuration of a flow control valve 59 is not limited to this, and can use various configurations, such as circular and a semicircle, suitably. Moreover, not only welding but a bis-stop, integral-construction-izing with passage, etc. can apply other various approaches also about the mounting arrangement of a flow control valve 59.
[0046] A flow control valve 69 tends to control temperature by adjusting refrigeration capacity. A flow control valve 69 opens and closes the slot 60 concerned according to the temperature of oxidizer gas. Although this flow control valve 69 is the same as a flow control valve 59 fundamentally, as for the flow control valve 59, the actuation direction of the valve to a temperature change is made into reverse. That is, the flow control valve 69 is constituted so that it may operate in the direction which will be opened if the temperature of oxidizer gas becomes higher than a design operating temperature (in namely, direction which increases the flow rate of oxidizer gas) and may operate in the direction which

will be closed if it becomes lower than a design operating temperature (in namely, direction which reduces the flow rate of oxidizer gas).

[0047] A separator 1 and the anode electrode 2 are determined for the construction material of the cathode electrode 4 and an electrolyte plate 3, a configuration, etc. according to the class of fuel cell. For example, when using a melting carbonate as an electrolyte, stainless steel can be used as a separator 1, and the porous body of a nickel alloy can be used as the anode electrode 2 and a cathode electrode 3. Moreover, the porous body of an alumina or magnesium can be used as an electrolyte plate 3.

[0048] The "fuel-flow control means" said in a claim is equivalent to a flow control valve 59 in this example. An "oxidizer control-of-flow means" is equivalent to a flow control valve 69. Moreover, a "fuel branch way" is equivalent to the space formed in each slot 50 and anode electrode 2. "The fuel branch way mutually arranged in juxtaposition" means the physical relationship slot 50a, b, c and d, and between e. Moreover, it realizes with the "oxidizer branch way" as space formed with each slot 60 and cathode electrode 3. "The oxidizer branch way mutually arranged in juxtaposition" means the physical relationship slot 60a, b, c and d, and between e.

[0049] The temperature control actuation in the fuel cell of this example is explained using drawing 4 .

[0050] drawing 4 showed signs that the cel of the fuel cell of this example was seen from the upside -- it is. In addition, since the structure of the fuel gas passage 5 is expressed, the part is used as perspective drawing. Moreover, it drew with the circle of a broken line by making into the abnormality section A the elevated-temperature part (or low-temperature part) generated in the cel side. In the slot 50, fuel gas 7 shall flow in the direction of a void arrow head. In the slot 60, oxidizer gas 8 shall flow in the direction of a black-colored arrow head.

[0051] Fuel gas 7 is supplied to the anode electrode 2 through a slot 50. Oxidizer gas 8 is similarly supplied to the cathode electrode 4 through a slot 60. And the electrical and electric equipment and heat are generated according to electrochemical reaction all over the anode electrode 2 and the cathode electrode 4.

[0052] When the current density and temperature in the abnormality section A are high unusually, slot 50a in the location corresponding to this abnormality section A and the fuel gas 7 which has passed b are an elevated temperature. Therefore, flow control valves 59a and 59b operate in the close direction, and the flow rate of the fuel gas 7 which flows through Slots 50a and 50b is decreased. Consequently, the reacting weight (namely, calorific value) of the electrochemical reaction in the field in alignment with slot 50a and b decreases, and current density and temperature fall.

[0053] With the fuel cell, the amount of supply of whole fuel cell Di's fuel gas is controlled by the pump 91 grade (refer to drawing 1). Therefore, only in the part by which the amount of the fuel gas 7 which flows Slots 50a and 50b was decreased, the amount of supply of fuel gas does not decrease as it is. The amount of the fuel gas 7 with which only the amount equivalent to at least the part of these decrements flows Slots 50c, 50d, and 50e increases. By this, while maintaining the output value in the whole fuel cell, equalization of the current density distribution and temperature distribution in the whole cel side can be attained. In such semantics, the flow control valve 59 will also demonstrate the distribution frame of the fuel gas to each slot 50. About this point, the same is said of a flow control valve 69.

[0054] The oxidizer gas 8 which has passed through Slots 60a and b is an elevated temperature similarly. Therefore, flow control valves 69a and 69b operate in the open direction, and increase the flow rate of the oxidizer gas 8 which flows Slots 60a and 60b. Consequently, the refrigeration capacity in the field along Slots 60a and 60b can increase, and the temperature in this field can be lowered.

[0055] When the current density and temperature in the abnormality section A are falling unusually, it acts on reverse with the above. That is, flow control valves 59a and 59b operate in the open direction, and the flow rate of the fuel gas 7 which flows through Slots 50a and 50b increases. Consequently, the reacting weight (namely, calorific value) of the electrochemical reaction in the field in alignment with slot 50a and b increases, and the current density and temperature in this field increase. Moreover, flow control valves 69a and 69b operate in the close direction, and the flow rate of the oxidizer gas 8 which flows through Slots 60a and 60b decreases. Consequently, the refrigeration capacity in the field along Slots 60a and 60b declines, and the temperature in this field increases.

[0056] In the part (the abnormality section A in this case) on which control (or buildup) of the calorific value according [the adjustment function of the current density and temperature which are realized by such mechanism] to a flow control valve 59, and buildup (or control) of the refrigeration capacity by the flow control valve 69 overlap and act, it will be demonstrated most effectively.

[0057] this example -- each slot 50 -- (-- although the flow control valve 59 (69) is attached in every 60), respectively, you may make it form a flow control valve 59 (69) like drawing 5 , after summarizing two or more slots 50 (60) to one Cost reduction can be planned if it does in this way. On the contrary, two or more flow control valves 59 (69) may be

formed in one slot 50 (60) like drawing 6 . If it does in this way, the range which can adjust a flow rate will become large.
[0058] The 2nd example of this invention is explained using drawing 7 .
[0059] This example is characterized by preparing flow-control-valve 59' (69') also in a just before [the intersection of a slot 50 (60) and the bypass slot 52 (62)] location while it forms the bypass slot 52 (62) which connects between each slot 50 of separator 1' (60). the part which is in the upstream from the bypass slot 52 (62) of a slot 50 (60) hereafter -- slot 50' (60') -- moreover, the part in the downstream is called slot 50" (60").
[0060] The configuration of flow-control-valve 59' and 69' itself is the same as that of the 1st example of the above. Moreover, it is the same as that of the 1st example of the above about other parts. In addition, drawing where drawing 7 (a) looked at separator 1' from the slot 50 side, and drawing 7 (b) are drawings which looked at separator 1' from the slot 60 side.
[0061] The bypass slot 52 (62) is formed so that between each slot 50 (60) may be connected. Thereby, not only the gas that has passed slot 50'a but a part of gas which has passed slot 50'b, and c, d and e can flow into slot 50a." Moreover, the inflow not only to slot 50a" but slot 50'b, and c, d and e of the gas which has passed slot 50'a conversely is attained.
[0062] In addition, slot 50' and slot 50" constitute "fuel branch way" where each is another. On the other hand, "the fuel branch way mutually arranged in juxtaposition" means the physical relationship slot 50'a, b, c and d, the physical relationship between e and slot 50"a, b, c and d, and between e. Similarly, the oxidizer branch way arranged in juxtaposition means the physical relationship slot 60'a, b, c and d, the physical relationship between e and slot 60"a, b, c and d, and between e.
[0063] Actuation is explained.
[0064] abnormalities -- the section -- B -- it can set -- current density -- and -- temperature -- unusual -- high -- becoming -- **** -- a case -- **** -- this -- abnormalities -- the section -- B -- immediately after -- a location -- it is -- a flow control valve -- 59 -- a -- ' -- 59 -- b -- ' -- the close direction -- operating . Then, the flow rate of slot 50a' and the fuel gas 7 which flows into 50b' decreases. Consequently, the reacting weight (namely, calorific value) of the electrochemical reaction in slot 50a' and the field (that is, the abnormality section B) in alignment with 50b' decreases, and current density and temperature fall.
[0065] a slot -- 50 -- a -- ' -- 50 -- b -- ' -- flowing -- fuel gas -- seven -- an amount -- having decreased -- a part -- inside -- at least -- a part -- a slot -- 50 -- c -- ' -- 50 -- d -- ' -- 50 -- e -- ' -- flowing . and -- a slot -- 50 -- a -- " -- 50 -- b -- " -- **** -- a slot -- 50 -- a -- ' -- 50 -- b -- ' -- passing -- having flowed -- gas -- not only -- a slot -- 50 -- c -- ' -- 50 -- d -- ' -- 50 -- e -- ' -- passing -- having flowed -- gas -- the pie bus slot 52 -- leading -- flowing in . Therefore, fuel gas is fully supplied to this slot 50a" and the field in alignment with 50b." That is, since fuel gas bypasses the abnormality section B and flows, it can make small the adverse effect which it has on parts other than the abnormality section B (the example of drawing 7 especially downstream part of the abnormality section B). Unlike the example of drawing 7 , when the abnormality section B arises in the downstream (that is, field of slot 50") more, similarly, fuel gas can bypass the abnormality section B and can flow.
[0066] on the other hand -- this -- abnormalities -- the section -- B -- immediately after -- a location -- it is -- a flow control valve -- 69 -- a -- ' -- 69 -- b -- ' -- the open direction -- operating . Then, the flow rate of slot 60a' and the oxidizer gas 8 which flows into 60b' increases, and the refrigeration capacity in the field in alignment with slot 60a' and 60b' increases. Consequently, the temperature of the abnormality section B falls.
[0067] a slot -- 60 -- a -- ' -- 60 -- b -- ' -- flowing -- an oxidizer -- gas -- eight -- an amount -- having increased -- a part -- only -- a slot -- 60 -- c -- ' -- 60 -- d -- ' -- 60 -- e -- ' -- flowing -- an oxidizer -- gas -- eight -- an amount -- decreasing . however -- a slot -- 60 -- c -- ' -- 60 -- d -- ' -- 60 -- e -- ' -- each -- ******** -- seeing -- if -- since the decrement is small -- an adverse effect -- there is nothing .
[0068] a slot -- 60 -- a -- ' -- 60 -- b -- ' -- passing -- having flowed -- an oxidizing agent -- gas -- a slot -- 60 -- a -- " -- 60 -- b -- " -- not only -- a pie -- a bus -- a slot -- 62 -- leading -- a slot -- 60 -- c -- " -- 60 -- d -- " -- 60 -- e -- " -- flowing in . Therefore, it is not in 60b" this slot 60a" and that the oxidizer gas of a large quantity flows in. That is, since oxidizer gas spreads in the whole again after it gathers from the whole oxidizer passage and cools the abnormality section B intensively, it can make small effect which it has on parts other than the abnormality section B (especially the downstream part and upstream part of the abnormality section B).
[0069] Finer control will be attained if many bypass slots 52 (62) are formed further.
[0070] In this 2nd example, while maintaining the output value in the whole fuel cell, much more equalization of the current density distribution and temperature distribution in the whole cel side can be attained.
[0071] Since each example explained above acts from the field of the both sides of refrigeration capacity and calorific value, it can perform control of current density and temperature effectively. Moreover, it is efficient in order to act on

an abnormality elevated-temperature (low temperature) part intensively. Since lowering of the amount of generations of electrical energy accompanying temperature control is suppliable in other normal parts, when it sees as the whole fuel cell, there is almost no lowering of an output. In order to **** and to make small reduction of the generation efficiency of the fuel cell itself as much as possible, as for buildup of refrigeration capacity, using as an auxiliary means is desirable.

[0072] In addition, the effectiveness by adjustment of such refrigeration capacity is useful especially in the fuel cell of the type which uses oxidizer gas for cooling essentially, i.e., a fused carbonate fuel cell etc.

[0073] When exact temperature control became possible, the partial corrosion within a cel side, deformation, scattering by electrolytic evaporation, etc. can be prevented. Moreover, useless consumption of fuel gas can be prevented. Furthermore, by having equalized current density distribution, the cel engine performance improves and generation efficiency rises. Moreover, the generation-of-electrical-energy inaction by lowering of temperature is also cancelable.

[0074] Moreover, since a complicated controlling mechanism etc. is not needed, it is advantageous also in respect of the dependability of equipment, and a manufacturing cost.

[0075] Furthermore, the configuration of this example may function also as an insurance device exceeding a role of a controlling mechanism of mere temperature and current density. That is, since flow control valves 59 and 69 operate in mutually-independent altogether, an overrun can be stopped because it will be in the condition which all the flow control valves 59 closed, and the condition that all the flow control valves 69 opened when a fuel cell begins an overrun (or beforehand prevention). And the dependability is extremely excellent. Generally, the insurance device is not operating at all, while the device (fuel cell in this case) is operating normally. Therefore, when accident occurs, it cannot usually check whether the insurance device operates normally. However, in this example, since it is operating from usually as controlling mechanisms, such as temperature, it can always check operating normally.

[0076] In the above-mentioned example, flow control valves 59 and 69 were realized using bimetal. However, the concrete implementation approach is not limited to this and may use a shape memory alloy. As a shape memory alloy, there are a TiNiNb alloy, a FeNiC alloy, a FeMnSi alloy, etc. What kind of thing is used should just choose suitably in accordance with a service condition etc.

[0077] Furthermore, the components of 1 do not necessarily need to combine the function which detects temperature, and the valve function to adjust a flow rate according to the detected temperature. For example, you may realize by combining the temperature sensor of a thermocouple, and the valve in which opening adjustment is possible. In addition, even when a temperature detection function and the flow adjustability are divided and considered in this way, as for the field set as the object of temperature detection, it is desirable that it is the outlet section of passage (slots 50 and 60). This is because the abnormalities caused in the downstream rather than the temperature detection object domain concerned are undetectable if temperature detection is performed in the middle of passage (slots 50 and 60). On the other hand, it is not necessary to necessarily arrange the valve for adjusting a flow rate in the outlet section of passage. Even if a valve arranges in the middle of the entry of passage etc. in which location, it is because it is possible to adjust the flow rate of the passage (slots 50 and 60) concerned.

[0078] The above-mentioned example was equipped with both the flow control valve 59 and the flow control valve 69. However, a certain amount of effectiveness also as a configuration equipped only with either is expectable.

[0079] Since the above-mentioned example aimed also at attaining equalization of the temperature within a cel side, and current density, it had prepared two or more branch ways juxtaposition-wise and in serial. Moreover, the passage of oxidizer gas and the passage of fuel gas were established in sense which crosses mutually. However, if it aims only at maintaining temperature at the predetermined range, need to divide passage and it is not necessary to establish it in plurality. Also when this example is applied without dividing passage into plurality, temperature control can be performed to accuracy. This is because detection of temperature etc. is performed immediately near the exoergic section.

[0080] Finally, the range which can apply the above-mentioned above-mentioned example is described.

[0081] The above-mentioned example explained only paying attention to the field of reacting weight control, without touching on fuel gas on the side face as a cooling medium. However, fuel gas may also function also as a cooling medium actually. Moreover, it is possible to also use oxidizer gas for reverse at reacting weight control. Therefore, in case this invention is applied, it is necessary to take the following points into consideration. However, the above-mentioned example is applicable to the bottom of the service condition of the fuel cell with which researches and developments are done actually as it is.

[0082] Reacting weight can apply the above-mentioned example to the bottom of a service condition which is not the flow rate of oxidizer gas and is determined with the flow rate of fuel gas (that is, service condition in which oxidizer gas exists superfluously to fuel gas). In operational status in which fuel gas exists superfluously to oxidizer gas, even if

it controls the flow rate of fuel gas, reacting weight cannot be adjusted. Under such a service condition, when the flow rate of fuel gas is reduced, it is only only causing reduction of the cooling effect by fuel gas. Moreover, when the flow rate of oxidizer gas is increased, reacting weight is made to increase on the contrary. To the bottom of such a service condition, flow control of oxidizer gas can perform control of reacting weight, and the flow rate of fuel gas can perform control of refrigeration capacity. Therefore, the actuation direction of flow control valves 59 and 69 is made into the above-mentioned example in this case at reverse. That is, if temperature becomes high, a flow control valve 59 will open and, on the other hand, a flow control valve 69 will be closed.
[0083] Moreover, if the fixed level which has a fuel gas flow rate under a service condition in which oxidizing agent gas exists superfluously to fuel gas is exceeded, even if it will increase a flow rate more than it, reacting weight hardly increases. It is the amount of the heat with which fuel gas takes buildup of a fuel gas flow rate in such a operating range.

[Translation done.]

* NOTICES *

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the block diagram showing the outline of the fuel cell which is the 1st example of this invention.
[Drawing 2] It is the perspective view showing the basic configuration of the cell contained in a fuel cell.
[Drawing 3] It is the perspective view showing the anchoring condition of a flow control valve 59 and a flow control valve 69.
[Drawing 4] It is drawing showing the working principle of this example.
[Drawing 5] It is drawing showing the modification of this 1st example.
[Drawing 6] It is drawing showing the modification of this 1st example.
[Drawing 7] this invention -- the -- two -- an example -- it can set -- a separator -- one -- ' -- and -- a flow control valve -- 59 -- ' -- 59 -- " -- 69 -- ' -- 69 -- " -- being shown -- drawing -- it is .
[Description of Notations]
1 .... Separator 2 .. Anode electrode 3 .. Electrolyte plate, 4 .... Cathode electrode 5 .. Fuel gas passage 6 .. Oxidizer gas passageway, 7 .... Fuel gas 8 .. Oxidizer gas 10 .. Flow control valve, 50 .... Slot 52 .. Bypass slot 59 .. Flow control valve 60 .. Slot 62 .. Bypass slot 69 .. Flow control valve 91 .. Pump 92 .. Pump A .. Abnormality section B .. Abnormality section

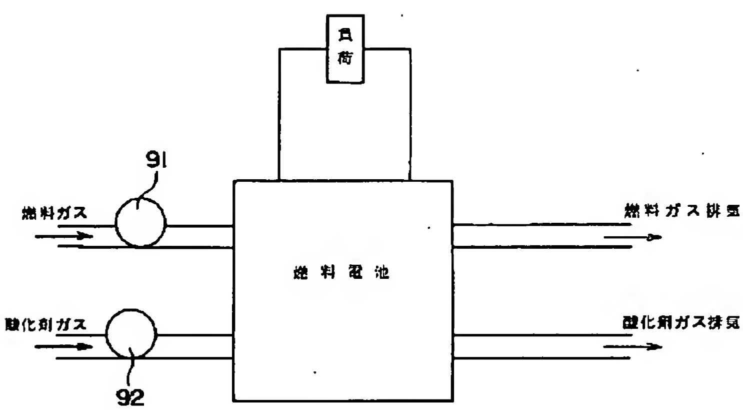
[Translation done.]

* NOTICES *

DRAWINGS

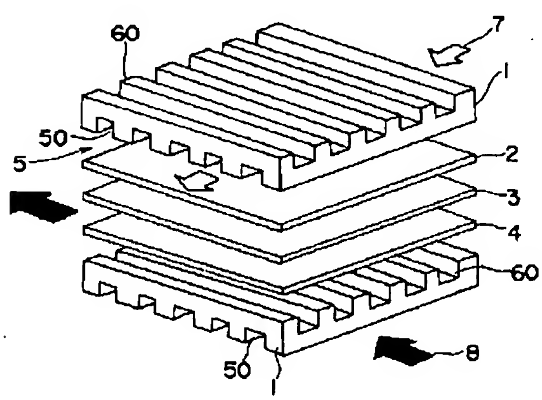
[Drawing 1]

図1



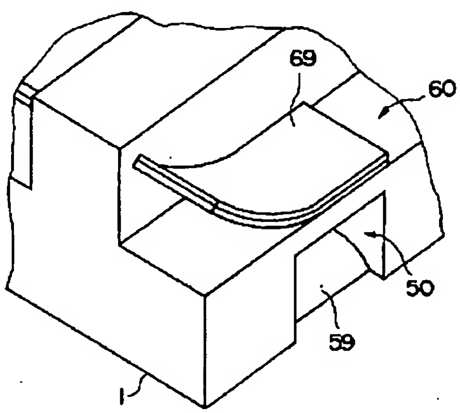
[Drawing 2]

図 2



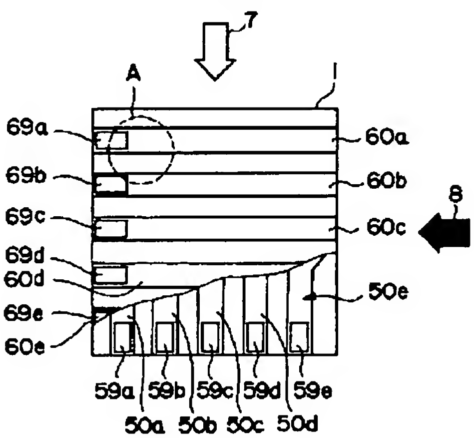
[Drawing 3]

図3



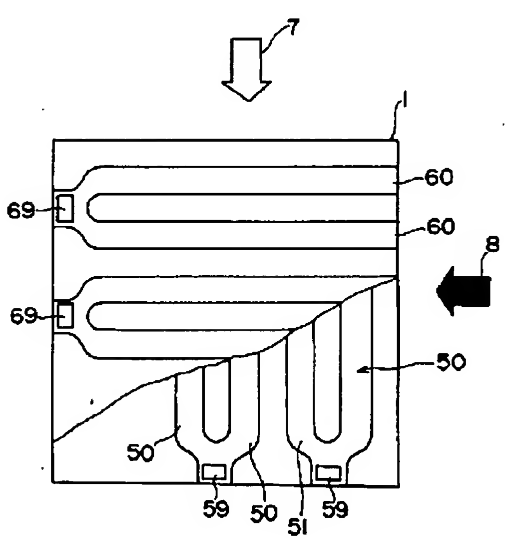
[Drawing 4]

図4



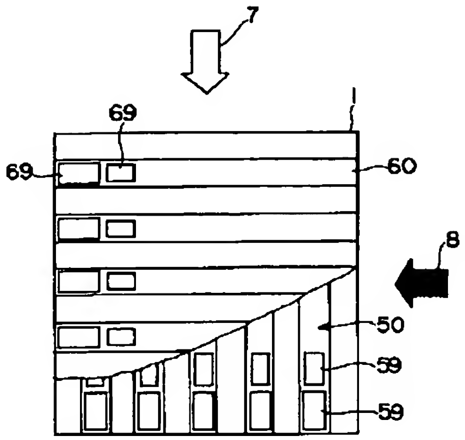
[Drawing 5]

図5



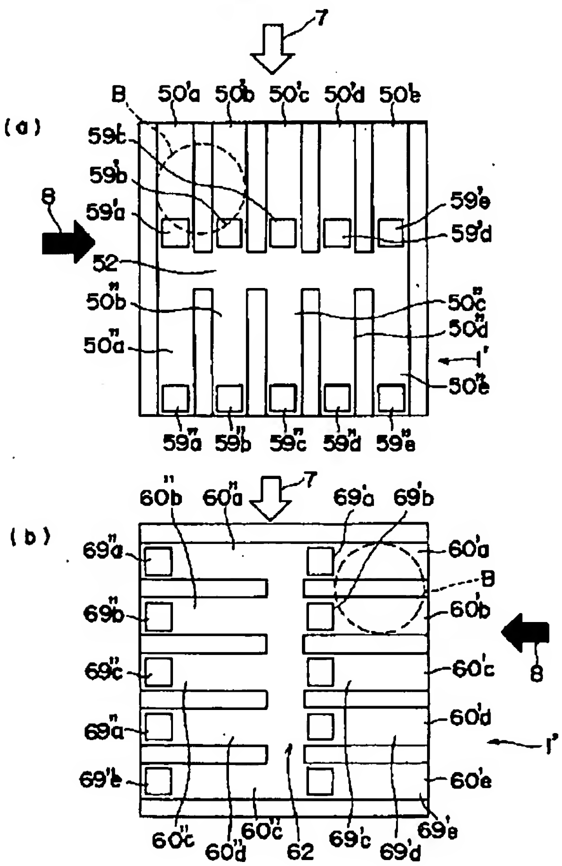
[Drawing 6]

図 6



[Drawing 7]

図 7



[Translation done.]